CLAIMS

1. A process for the manufacture of a packaging material, the process comprising
   (i) applying a tie layer of molten polyolefin to a water-absorbent layer,
   (ii) optionally exposing the product of (i) to pressure,
   (iii) applying an outer layer of polyolefin to the tie layer,
   (iv) exposing the product of (iii) to pressure, and
   (v) allowing the material to cool,
   wherein the tie layer of polyolefin partially impregnates the water-absorbent layer.

2. A process according to claim 1, wherein the outer layer is molten.

3. A process according to claim 1 or claim 2, wherein the polyolefin comprises polyethylene, polyvinylchloride, polypropylene, or mixtures thereof.

4. A process according to any preceding claim, wherein the outer and/or tie layers further comprise an additive selected from the group consisting of a colour agent, an adhesive and a surface slip agent.

5. A process according to any preceding claim, wherein the outer and tie layers have the same composition.

6. A process according to any one of claims 1 to 4, wherein the outer and tie layers have a different composition.

7. A process according to any preceding claim, wherein the outer layer is thicker than the tie layer.

8. A process according to any preceding claim, wherein the tie layer has a thickness of from about 5 to about 10 microns.

9. A process according to any preceding claim, wherein the outer layer has a thickness of from about 15 to about 30 microns.

10. A process according to any preceding claim, wherein the outer and/or tie layer is applied by extrusion.

11. A process according to any preceding claim, wherein pressure is applied by passing the layers through a nip point.

12. A process according to claim 11, wherein the outer and tie layers form a solid proximal to, or at, the nip point.

13. A process according to any preceding claim, wherein the pressure is from about 400 to about 800 kPa.

14. A process according to claim 13, wherein the pressure is about 550 kPa.

15. A process according to any preceding claim, wherein the outer and/or tie layer of molten polyolefin has a temperature of from about 200 °C to about 300 °C.

16. A process according to claim 15, wherein the outer and/or tie layer of molten polyolefin has a temperature of about 250 °C.

17. A process according to any preceding claim, wherein step (v) comprises passing the material over a series of rollers, and then winding the material on a reel.

18. A process for the manufacture of a packaging material, the process comprising

(i) applying an adhesive comprising an alpha cyanoacrylate or a liquid epoxy and amine to one or both of

(a) a surface of a liquid water- and water vapour-impermeable outer layer, and

(b) a surface of a water-absorbent layer,

(ii) contacting said surfaces, and

(ii) allowing the adhesive to harden.

19. A process according to claim 18, wherein the bonding comprises the application of a heat-melt glue.

20. A process according to any preceding claim, wherein the process further comprises bonding a water vapour-permeable inner layer to the water-absorbent layer, wherein the water vapour-permeable inner layer is substantially impermeable to liquid water in the water-absorbent layer.

21. A process according to claim 20, wherein the inner layer is bonded to the water-absorbent layer over less than 5% of the surface area of the inner layer.

22. A packaging material produced by a process according to any preceding claim.

23. A packaging material comprising

(i) a liquid water- and water vapour-impermeable outer layer,

(ii) a water-absorbent layer,

(iii) a tie layer bonded to the outer layer and the water-absorbent layer, and

(iv) a water vapour-permeable inner layer which is substantially impermeable to liquid water in the water-absorbent layer,

wherein the tie layer partially impregnates the water-absorbent layer.

24. A packaging material according to claim 23, wherein the water vapour-permeable layer is bonded to the water absorbent layer.

25. A packaging material according to claim 23 or claim 24, wherein the outer layer comprises a petrochemical- or plant-derived organocarbon.

26. A packaging material according to claim 25, wherein the organocarbon is a polyolefin.

27. A packaging material according to claim 26, wherein the polyolefin is polyethylene, polyvinylchloride, polypropylene or a mixture thereof.

28. A packaging material according to claim 23, wherein the outer layer and the tie layer comprise polyethylene, polyvinylchloride, polypropylene, or mixtures thereof.

29. A packaging material according to claim 28, wherein the outer layer and/or tie layer further comprise an additive selected from the group consisting of: a colour agent, an adhesive, and a surface slip agent.

30. A packaging material according to claim 23, wherein the outer layer and tie layer have the same composition.

31. A packaging material according to claim 23, wherein the outer layer and tie layer have a different composition.

32. A packaging material according to any one of claims 23 to 31, wherein the outer layer is thicker than the tie layer.

33. A packaging material according to any one of claims 23 to 32, wherein the tie layer has a thickness of from about 5 to about 10 microns.

34. A packaging material according to any one of claims 23 to 33, wherein the outer layer has a thickness of from about 15 to about 30 microns.

35. A packaging material according to any one of claims 23 to 34, wherein the outer layer contacts at least 90% of a surface of the tie layer.

36. A packaging material according to any one of claims 23 to 35, wherein the water-absorbent layer contacts at least 90% of a surface of the tie layer.

37. A packaging material according to any one of claims 23 to 36, wherein the water-absorbent layer is able to adsorb at least 50 g of water per m^2.

38. A packaging material according to any one of claims 23 to 37, wherein the water-absorbent layer comprises cellulose fibres.

39. A packaging material according to any one of claim 38, wherein the water-absorbent layer has a specific weight of from about 15 to about 30 g/m^2.

40. A packaging material according to any one of claims 23 to 39, wherein the water-absorbent layer has a thickness of from about 60 to about 95 microns.

41. A packaging material according to any one of claims 23 to 40, wherein the water-absorbent layer has an machine direction tensile of from about 15N/75 mm to about 35N/75 mm.

42. A packaging material according to any one of claims 23 to 41, wherein the water-absorbent layer further comprises a bioactive molecule, or a precursor thereof where the bioactive molecule is released upon exposure to water.

43. A packaging material according to claim 42, wherein the bioactive molecule is selected from the group consisting of SO_2 and 1-methylcyclopropene.

44. A packaging material according to any one of claims 23 to 43, wherein the inner layer comprises hydrophobic polyolefin.

45. A packaging material according to claim 44, wherein the hydrophobic polyolefin is a spun-bond polypropylene.

46. A packaging material according to any one of claims 24 to 45, wherein the wherein the inner layer is bonded to the water-absorbent layer over less than 5% of the surface area of the inner layer.

47. A packaging material according to claim 46, wherein the inner layer is bonded to the water-absorbent layer by a heat-melt glue.

48. A packaging material comprising

(i) a liquid water- and water vapour-impermeable outer layer,

(ii) a water-absorbent layer,

(iii) an adhesive layer comprising an alpha cyanoacrylate or a liquid epoxy and amine bonded to the outer layer and the water-absorbent layer, and

(iv) a water vapour-permeable inner layer which is substantially impermeable to liquid water in the water-absorbent layer,

wherein the water vapour-permeable inner layer is bonded to the water-absorbent layer.

49. A packaging material comprising

(i) a liquid water- and water vapour-impermeable outer layer,

(ii) a water-absorbent layer, and

(iii) a water vapour-permeable inner layer which is substantially impermeable to liquid water in the water-absorbent layer,

wherein the water-absorbent layer comprises cellulose fibres and has a specific weight of from about 15 to about 30 g/m^2 and a thickness of from about 60 to about 95 microns, and wherein the water vapour-permeable inner layer is bonded to the water-absorbent layer.

50. A packaging material according to any one of claims 22 to 49, further comprising a supporting layer that provides mechanical strength and which contacts the outer layer.

51. A packaging material according to claim 50, wherein the supporting layer is a corrugated paper carton.

52. A method of storing and/or transporting a perishable product, the method comprising inserting the product into, or substantially wrapping the product with, packaging material according to any one of claims 22 to 51.

53. A method of storing and/or transporting a perishable product, the method comprising the following steps;

(i) inserting the product into an open container lined with packaging material according to any one of claims 22 to 51,

(ii) placing a sheet of packaging material according to any one of claims 22 to 51 over the product facing the open area of the container, and

iii) placing a lid on the container.

54. A method of storing and/or transporting a perishable product, the method comprising the following steps;

(i) inserting the product into an open container lined with packaging material according to any one of claims 22 to 51, wherein the lining extends beyond the walls of the container,

ii) placing the lining extensions over the product facing the open area of the container, and

iii) placing a lid on the container.

55. A method according to any one of claims 52 to 54, wherein the perishable product is horticultural produce.

56. A system for controlling an oxygen concentration of an enclosed atmosphere containing respiring produce, the system comprising:

(i) an enclosure to isolate the enclosed atmosphere from an external atmosphere;

(ii) an oxygen sensor for sensing the oxygen concentration of the enclosed atmosphere;

(iii) a pump for pumping the external atmosphere into the enclosed atmosphere;

(iv) a control means for causing the pump to commence operation when an oxygen concentration of the enclosed atmosphere is less than a predetermined minimum concentration, and for causing the pump to cease operation when an oxygen concentration of the enclosed atmosphere exceeds a predetermined maximum concentration; and

(v) means to allow egress of the enclosed atmosphere from the enclosure during operation of the pump.

57. A system according to claim 56, wherein the pump is a battery powered pump.

58. A system according to claim 57, wherein the enclosure contains a pallet-load of respiring produce.

59. A system according to claim 58, further comprising one or more D-cell batteries to power the battery powered pump.

60. A system according to claim 57, wherein the enclosure contains a container-load of respiring produce.

61. A system according to claim 60, further comprising a rechargeable battery of at least 12V to power the battery powered pump.

62. A system according to claim 61, further comprising means to recharge the rechargeable battery from a container power supply when the container power supply is powered.

63. A system according to any one of claims 56 to 62, wherein the means to allow egress of the enclosed atmosphere from the enclosure during operation of the pump comprises a flow path, the flow path being configured to allow mass flow of the enclosed atmosphere out of the enclosure while limiting diffusion between the external atmosphere and the enclosed atmosphere to a rate less than a rate of respiration of the respiring produce in the enclosed atmosphere.

64. A system according to claim 63, wherein the means to allow egress of the enclosed atmosphere from the enclosure during operation of the pump comprises a venting tube, wherein a bore of the venting tube provides the flow path.

65. A system according to claim 64, wherein a length of the venting tube is significantly greater than a cross-sectional dimension of the venting tube so as to limit diffusion between the external atmosphere and the enclosed atmosphere.

66. A system according to claim 65, wherein the enclosure contains a pallet-load of respiring produce, and wherein the length of the venting tube is not less than about 30 centimetres, and the cross sectional dimension of the venting tube is no more than about 4 millimetres.

67. A system according to claim 65, wherein the enclosure contains a pallet load of high respiring produce, and wherein the length of the venting tube is not less than about 15 centimetres, and the cross sectional dimension of the venting tube is at least about 4 millimetres.

68. A system according to claim 63, wherein the means to allow egress of the enclosed atmosphere from the enclosure during operation of the pump comprises a plurality of baffles, the flow path being provided by an aperture in each baffle.

69. A system according to claim 68, wherein the baffles are placed in substantially parallel alignment at small spacings.

70. A system according to claim 68 or claim 69, wherein an aperture of each baffle is distal from an aperture of each adjacent baffle so as to provide a long diffusion path between the enclosed atmosphere and the external atmosphere.

71. A system according to any one of claims 56 to 70, wherein the oxygen sensor continuously operates to sense the oxygen concentration of the enclosed atmosphere.

72. A system according to any one of claims 56 to 71, wherein the oxygen sensor provides an output voltage which is representative of oxygen concentration.

73. A system according to claim 72, wherein the oxygen sensor is a galvanic cell - type sensor operable in the absence of a separate power source.

74. A system according to claim 73, wherein the oxygen sensor comprises a thermistor for temperature compensation.

75. A system according to claim 74, wherein the oxygen sensor is a KE-25 sensor.

76. A system according to any one of claims 56 to 75, wherein the enclosure is a polyethylene bag.

77. A system according to claim 76, wherein the polyethylene bag has an opening large enough to enable respiring produce to be stacked into the bag while on a pallet, such that sides of the bag may be drawn up around the stacked produce and the opening sealed in order to form the enclosure.

78. A method for controlling an oxygen concentration of an enclosed atmosphere containing respiring produce, the method comprising:

(i) isolating the enclosed atmosphere from an external atmosphere;

(ii) sensing the oxygen concentration of the enclosed atmosphere;

(iii) commencing pumping of the external atmosphere into the enclosed atmosphere when an oxygen concentration of the enclosed atmosphere is less than a predetermined minimum concentration;

(iv) ceasing pumping of the external atmosphere into the enclosed atmosphere when an oxygen concentration of the enclosed atmosphere exceeds a predetermined maximum concentration; and

(iv) providing means to allow egress of the enclosed atmosphere from the enclosure during said pumping.

79. A method according to claim 78, wherein the step of sensing is performed continuously.

80. A method according to claim 78 or claim 79, wherein the step of isolating the enclosed atmosphere containing respiring produce from an external atmosphere comprises placing a polyethylene bag on a pallet, stacking the respiring produce into the bag on the pallet, drawing sides of the bag around the stacked respiring produce, and sealing the bag.

81. A method according to claim 80, wherein the step of stacking the respiring produce comprises forming a central void within the stacked produce, in order to facilitate even atmospheric conditions throughout the enclosed atmosphere.

82. A method according to claim 78 or claim 79, further comprising providing a rechargeable power source operable to be recharged from a container power supply when the container is externally powered, and operable to power the pump and control means when the container is not externally powered.

83. A method according to any one of claims 78 to 82, wherein the step of sensing the oxygen concentration is performed by providing a galvanic cell -type oxygen sensor.

84. A method according to claim 83, wherein the steps of commencing and ceasing pumping are carried out by reference to an output voltage of the sensor.

85. A method according to any one of claims 78 to 84, wherein the step of providing means to allow egress of the enclosed atmosphere from the enclosure

comprises providing a flow path which permits mass flow from the enclosed atmosphere to the external atmosphere, while limiting diffusion between the enclosed atmosphere and the external atmosphere to a rate less than a rate of respiration of the respiring produce in the enclosed atmosphere.

86. A method according to claim 85, wherein the flow path is provided by way of a venting tube.

87. A method according to claim 85, wherein the flow path is provided by way of a plurality of baffles each having an aperture.

88. A method according to any one of claims 52 to 55, further comprising placing the container in an enclosure in which the oxygen concentration within and/or surrounding the packaging material is regulated.

89. A method according to claim 88, wherein the oxygen concentration is regulated by a method of any one of claims 78 to 87.

90. A packaging system comprising a container containing a perishable product and packaged according to any one of claims 52 to 55 placed within an enclosure which substantially seals the container from the atmosphere.

91. A system according to claim 90, further comprising a means for regulating the oxygen concentration within the enclosure.

92. A system according to claim 91, in which the means for regulating the oxygen concentration comprises a system according to any one of claims 56 to 77.

93. A system according to any one of claims 90 to 92, in which the enclosure is a plastic material.

94. A system according to any one of claims 90 to 92, in which the enclosure is a metal freight container.